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(54) GRANULES CONTAINING CALCIUM AND/OR MAGNESIUM-BEARING RAW MATERIAL AND AN EXPANDING CLAY BINDING AGENT, AND A PROCESS FOR MAKING THE SAME

(71) We, AMERICAN PELLETIZING CORPORATION (formerly Calcium Products Corporation), a corporation organized under the laws of the State of Indiana, United States of America, of P.O. Box 270, Aurora, Indiana, United States of America, do hereby declare the invention for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention is concerned with improved granules of calcium and/or magnesium-bearing raw material and a binding agent of an expanding clay material, and with a process of making the granules.

As will be developed hereinafter, the granules of the present invention have many uses. However, for the purposes of an exemplary showing, the granules will be primarily described with respect to their use as a soil neutralizer and conditioner.

Calcium and/or magnesium-bearing materials, such as limestone ($CaCO_3$) and dolomitic limestone ($CaCO_3MgCO_3$), have long been used to reduce soil acidity. In a readily available form for agricultural purposes, limestone generally consists of about 80% by weight of particles which pass through an 8 mesh screen (all screen sizes stated hereinafter and in the claims are in accordance with the United States Bureau of Standards), and 20% by weight of particles which will not pass through an 8 mesh screen.

Unfortunately, limestone of a particle size larger than 60 mesh is slow to react with the soil. Where rapid soil neutralizing is required, it would be desirable to grind the limestone so that 100% of it will pass through a 60 mesh screen or finer. However, such material presents handling problems including caking, dust and difficulty in confining it to the desired area.

To overcome these problems, prior art workers have striven to provide limestone granules through the use of binder materials and granulating agents. United States Patent No. 3,214,261 is an example of the teachings of such granules and a method of making them.

In accordance with this prior United States Patent, binder materials such as diammonium phosphate, urea, or ammonium sulfate are used. The limestone and binder material are mixed in a dry state at a weight ratio of about 90% to 97% by weight limestone to 3% to 10% by weight binder material. When the limestone contains little or no magnesium, 3% to 7% of additional binder material is required.

The dry mix of limestone and binder material is granulated by the addition of a granulating agent such as water in an amount of from 10% to 20% by weight of the dry mix.

Soil neutralizers of the type taught in the aforementioned United States Patent have certain disadvantages. First of all, the binder materials are expensive and are of such nature as to require the soil neutralizer to be classified as a soil nutrient or fertilizer, which is confusing to the consumer. In addition, the binder materials, which are harmful, are acidic and cause corrosion problems to the equipment used in the manufacturing process, adding to the cost of the soil neutralizers.

Furthermore, the neutralizing effect of such soil neutralizers is impaired by virtue of the acidic influence of the binder materials used and the dilution of the active material. The high percentage of binder materials required reduces the content of the neutralizing material in the end product. Finally, a

substantial amount of water is required to dissociate or break down the soil neutralizers of the type taught in the above noted patent, delaying the availability of the calcium and magnesium carbonates to the soil.

Whilst other prior art patents such as United States Patents Nos. 2,702,747; 2,976,162 and 3,615,811 have suggested the use of clays for coating fertilizers, for briquets to be used for melting furnace charges and as dispersants and binder additives to provide products for use in ceramic industries, respectively, there has been no suggestion of using an expanding clay as a binder material to produce a granular soil neutralizer.

The granular soil neutralizer of the present invention is produced using an expanding clay as a binder material. The expanding clay binder material has no acidity or plant food value, is inexpensive and materially increases the water and nutrient holding ability of the soil.

In the practice of the present invention, far less binder material and granulating agent are required than in the above described prior art granules. The product of the present invention is characterized by stable granules which are free flowing, dust free and non-hygroscopic. As will be described hereinafter, the product of the present invention may be produced as a light weight product.

According to one aspect of the invention, granules are provided consisting of from 90% to 98% by weight of a finely-divided calcium and/or magnesium-bearing raw material selected from the group consisting of limestone, dolomitic limestone, burned lime, marl, oyster shells, and slag, and 2% to 10% by weight of a binding agent selected from the group of high-expansion clays consisting of sodium bentonite, calcium bentonite and montmorillonite, the binding agent causing cohesion of the raw material into granules which disintegrate when in contact with water; the granules being of a size that they will pass a 4 mesh screen and be retained on a 60 mesh screen.

Preferably the granules are produced in two size ranges, in one of which the granules will pass a 4 mesh screen and be retained on a 20 mesh screen, and in the other size range, the granules will pass a 20 mesh screen and be retained on a 60 mesh screen.

Preferably the raw material comprises 97% to 97.9% by weight and the binding agent comprises 2.1% to 3% by weight.

Preferred granules consist of either limestone or dolomitic limestone as the raw material, with either sodium bentonite or calcium bentonite as the binding agent.

According to another aspect of the invention, there is provided a process of preparing granules which comprises the steps:

(A) mixing from 90% to 98% by weight of a dry, finely divided calcium and magnesium-bearing raw material selected from the group consisting of limestone, dolomitic limestone, burned lime, marl, oyster shells, and slag, with from 2% to 10% by weight of a binding agent selected from the group of high expansion clays consisting of sodium bentonite, calcium bentonite and montmorillonite;

(B) agitating the mixture and gradually adding from 6% to 15% by weight of water, based on the weight of the dry material, to the dry mixture to form granules, said water being sufficient in amount to activate the binding agent and less than an amount required to form a slurry;

(C) drying the granules at a temperature within the range from 200° to 600°F; and

(D) screening the dried granules to recover those granules having a particle size which will pass through a 4 mesh screen and be retained on a 60 mesh screen, said granules containing from 90% to 98% by weight of said raw material and from 2% to 10% by weight of said binding agent.

Preferably following said initial mixing a portion of the mix is continuously recycled for further mixing to produce the needed percentage of fines for a more uniform final product.

Preferably 8% by weight of water, based on the weight of the dry material is gradually added to the dry mix during said agitating step.

Preferably the granules are dried at a temperature of about 350°F.

Preferably the initial mixing step (A) includes grinding, and the grinding and mixing is accomplished in one step by use of a cage mill, whereby the necessity for predrying the calcium and magnesium-bearing raw material prior to grinding is eliminated.

Thus it will be seen that the granules of the present invention are formed from raw material which is high in calcium and/or magnesium and a binder material comprising a high expanding clay. The raw material and binder material are continuously fed into and intimately mixed in a pulverizer, such as a cage mill. A portion of the homogeneous mix from the cage mill (or other impact type grinder) is preferably continuously recycled back through the cage mill. This procedure eliminates the need for drying and separating equipment to remove oversized material. The remainder of the cage mill mix is transferred to a granulator wherein granules are formed through the use of water as a granulating agent. This eliminates the need for a settlement pond. Only a final product of the desired size or sizes is used, fines and oversized material being recycled.

Material from the granulator is introduced into a dryer-cooler and thence to a finished

product screen means. The finished product screen means provides a finished product in one or more sizes. Fines from the finished product screen means are recycled to the cage mill. Oversized material from the finished product screen means is also recycled to the cage mill.

The granules of the present invention dissociate rapidly when wet, with the high expanding rate of the binder material upon absorption of moisture forcibly dissociating or breaking down the granules to make the neutralizing material therein readily and rapidly available to the soil in the fastest possible time. The harmless expanding clay binder material also markedly increases the water and nutrient holding ability of the soil. Finally, since the expanding clay binding materials are alkaline, having a pH in substantially the same range as limestone, they add to the neutralizing value of the finished granules.

The invention will now be described in detail and is illustrated, by way of example, in the accompanying drawing which is a diagrammatic representation of a process according to the present invention.

It will be understood that the term "soil conditioner" as used herein is intended to mean a compound or composition used to raise the pH of the soil.

The raw material of the present invention preferably comprises limestone of the type having a high $CaCO_3$ content of about 97% (about 39% calcium by weight) or a dolomitic limestone having a total $CaCO_3$ and $MgCO_3$ content of about 97%, the calcium carbonate portion thereof containing about 39% calcium by weight and the magnesium carbonate portion thereof containing about 28% magnesium by weight. However, such materials may also comprise burned lime, marl, crushed oyster sheels, or slag. Such materials preferably will contain about 25% by weight of calcium.

In the drawing, a storage means or hopper for the raw material is shown at 1. The raw material, which may be of any size but preferably of about 1 inch or less, is charged by means of a conveyor 2 to a pulverizing means 3.

The binding agent calcium bentonite swells, when wetted, to a maximum of about twice its dry volume. Sodium bentonite, on the other hand, swells to as much as 20 times its dry volume, when wetted.

The expanding clays, used as binding agents in the invention, have been found to markedly increase the moisture and nutrient holding capacity of the soil, when present in small quantities in the soil. Furthermore, the swelling abilities of the expanding clays make them excellent binder materials, producing strong, stable, non-hygroscopic granules. The high expanding rate of the expanding clays upon absorption of moisture forcibly dissociates or breaks down the granules to make the neutralizing material therein readily and rapidly available to the soil in the fastest possible time. The expanding clays have substantially no acidity or plant food value and are inexpensive. However, since the expanding clays are alkaline, having a pH in substantially the same range as limestone, they in fact add to the neutralizing value of the finished granules.

In the drawing, a storage means for the binder material is shown at 4. The binder material, preferably in a powder or granular form, is metered into the charge of raw material passing to the pulverizing means 3, as at 5.

The pulverizing means 3 may take any suitable form. A cage mill or other impact type grinding equipment has been used with complete success. The metering of the binder material into the charge of raw material for the pulverizer 3 eliminates the need for additional mixing equipment and reduces the amount of binder material required. This is true since an intimate, completely homogeneous mix is obtained as a result of the high energy mixing action of the cage mill. In the practice of the present invention, it has been found that the expanding clay binder material may be added to the raw material in an amount of from 2% to 10% by weight of the dry mix. However, in most applications the binder material may be present in an amount of from 2.1% to 3% by weight of the dry mix and, normally, in an amount of about 2.5% by weight of the dry mix.

The mix within the cage mill, which is used for both grinding and mixing in a one step operation, is reduced to a size such that all or a substantial portion thereof will pass a 100 mesh screen. To assure a proper size of the raw material binder mix from the cage mill and a proper size of the final product, a portion of the mix from the cage mill is continuously recycled through the cage mill. The use of a cage mill or similar pulverizing means 3 eliminates the necessity for predrying the limestone feed in order to grind it. The moisture content of the limestone feed will vary from 0 to 6%, but will normally be about 2% or higher.

The continuous recirculation of a portion of the mix containing oversized material from the pulverizer 3, via recycle line 6 back to the pulverizer, eliminates the necessity for screening the mix in order to remove oversize particles. It has also been found that this recirculating procedure produces the needed fines for a more uniform final product. The amount of material recirculated is dependent upon a number of variables; such as, for example, the moisture content,

hardness and particle size of the raw and binder materials, the type of pulverizer or cage mill utilized in the process, and the fineness of the raw and binder materials necessary to pelletize and form the desired end product, and is best determined by routine experimentation, selecting that amount of recirculation which will yield the best end product.

If the raw material feed in conveyor 2 is already sufficiently fine, the pulverizer 3 may be replaced by a high energy mixer. A high energy mixer is required to assure the required homogeneous mix of raw material and binder material.

That portion of the mix from the pulverizer 3, which is not recirculated, is conveyed as at 7 to a granulator 8. The granulator 8 may be of any conventional and well known type including a rotary driven or pan-type granulator. While a rotary drum type granulator may be utilized, it has been found that pan-type granulator is preferable. This is so because the dropping of material in the rotary drum has a tendency to cause the formation of globular shaped particles if the moisture content of the raw and binder material mix is a little too high. In the granulator, water is added to mix, as at 9, and granules are formed. With the binder materials of the present invention, it has been found that preferably 8% of water based on the weight of the dry material is sufficient as a granulating agent for the binder material.

Granules from the granulator are conveyed as at 10 and 15 via a scalping screen 11 to the dryer-cooler 16. The dryer-cooler 16 is of the conventional fluid bed type wherein the granules are subjected to a flow of air at a temperature within the range from 200°F. to 600°F., and normally at a temperature about 350°F. However, it will, of course, be understood that the drying temperature is based upon a combination of temperature, air volume and retention time of the granules in the dryer-cooler 16.

It should, perhaps, be noted that it has been found in practice that if the granulator 8 is of the rotary drum type, granules therefrom should be directed to the scalping screen 11 (as shown in dashed lines) which is of the well known single-deck type prior to their direction to the dryer-cooler 16. The scalping screen eliminates oversize, malformed granules which are recirculated to the pulverizer 3 via recycle line 12 and the conveyor means 21 leading back to the pulverizer 3.

From the dryer-cooler 16, the granules are conveyed as at 17 to the finished product screen means 18. Again, the screen means 18 may be conventional and may have any appropriate arrangement, depending upon the product or products desired.

In the drawing, the finished product screen means 18 is diagrammatically indicated as a three-deck screen means whereby the finished product is provided in two preferred size ranges as stated. There is provided at 19 a conveying means for a first product so sized that 100% will pass a 4 mesh screen and 100% will be retained by a 20 mesh screen, and at 20 there is provided a conveyor means for a product so sized that 100% will pass through a 20 mesh screen and 100% will be retained by a 60 mesh screen. Fines (i.e. that material passing through a 60 mesh screen) and oversized material are returned via a conveyor means 21 to the pulverizer 3. It should be noted that the expanding clay binder of the present invention is such an efficient binder in agglomerating the raw material that the process generally creates a maximum of about 0.7% oversize material and about 5.4% fines by weight.

The finished product may either be bagged or shipped in bulk. None of the constituents of the final product are hygroscopic, and therefore the product is not materially affected by being exposed to the atmosphere. The final product is characterized by strong, uniform granules.

The size of the granules of the finished product, within the stated ranges, does not constitute a limitation on the present invention. For example, if the product is to be mixed with fertilizer granules or the like, it may be desirable to provide granules of such size that 100% pass through an 8 mesh screen and 100% are retained by a 20 mesh screen. It has been found, for example, that a product having a granule size such that 100% pass through an 8 mesh screen and 100% are retained by a 30 mesh screen has excellent spreading characteristics, the granules being stable, free flowing and dust free.

In the practice of the present invention it has been found advantageous to use water derived from a wet scrubber 13 as the granulating agent entering granulator 8 via the conduit 9. The wet scrubber 13 is a vessel filled with water, and fines or, in other words, very small dust like particles which are not agglomerated, are recycled from the dryer-cooler 16 into the wet scrubber 13. The fine material settles to the bottom of the wet scrubber 13 forming a sediment layer. This sediment layer is then removed via line 9, and recycled into the pelletizer or granulator 8. In this manner the fines are recycled and granulated into the desirable pellets of this invention. The wet scrubber serves a further advantage in that the dust like particles are often a nuisance in the manufacturing process and the nuisance of the dust is avoided by employing the wet scrubber in the manner described.

The use of the wet scrubber 13 as a source of water for the granulator 8, conserves fuel since the water from the scrubber 13 is already hot, and eliminates the need for a settling pond or other water pollution control equipment.

Examples of the present invention are given as follows:

EXAMPLE 1

1050 pounds per hour of sodium bentonite in pulverized form was metered into a stream of 48,950 pounds per hour (dry basis) of limestone containing 97.78% calcium carbonate. The limestone had a lump size of less than 1 inch. The limestone-bentonite stream was fed into a 50 inch cage-type pulverizer wherein it was intimately mixed and reduced to a particle size such that 75% passed a 100 mesh screen. Approximately 33% of the mix from the pulverizer was recirculated through the pulverizer continuously.

The mix from the pulverizer was fed to a 15 foot diameter pan granulator into which water from the scrubber was sprayed onto the incoming mix. The water was introduced into the granulator at the rate of about 6,500 pounds per hour.

The granulator pan was given an inclination of about 60° and was rotated at about 17 rpm. Pellets from the granulator were dried in a 5 foot by 25 foot fluid bed dryer-cooler with air at a temperature of 350°F. The dried material from the dryer-cooler was conveyed to a finished product screen means wherein it was separated into three sizes: a finished product such that 100% was passed by an 8 mesh screen and 100% was retained by a 30 mesh screen; fines passed by the 30 mesh screen and oversized material retained by the 8 mesh screen. The fines and oversized material were recycled to the granulator via the pulverizer. The finished product represented 88% of the material from the dryer-cooler and had a calcium carbonate content of 96.33% by weight. The finished product contained 2.1% binder material and 97.9% raw material by weight.

EXAMPLE 2

The same procedure was followed as indicated in Example 1, except that dolomite was substituted for the limestone. The dolomite had a magnesium carbonate content of 41.2% by weight and a calcium carbonate content of 56.1% by weight. The final product had a total carbonate content of 95.5% by weight. The final product contained 2.1% binder and 97.9% raw material by weight.

EXAMPLE 3

The same procedure was followed as indicated in Example 1, except that 2500 pounds per hour of sodium bentonite in pulverized from was metered into a stream of 47,500 pounds per hour (dry basis) of limestone containing 97.78% calcium carbonate. The finished product represented 91% of the material from the dryer-cooler and had a calcium carbonate content of 92.89% by weight. The finished product contained 5.0% binder material and 95.0% raw material by weight.

EXAMPLE 4

The same procedure was followed as indicated in Example 1, except that 5000 pounds per hour of sodium bentonite in pulverized form was metered into a stream of 45,000 pounds per hour (dry basis) of limestone containing 97.78% calcium carbonate. The finished product represented 91% of the material from the dryer-cooler and had a calcium carbonate content of 92—89% by weight. The finished product contained 10.0% binder material and 90.0% raw material by weight.

The final product of each of the four Examples hereinbefore referred to had a granule size such that 100% of them passed through an 8 mesh screen and 100% of them were retained by a 30 mesh screen. The comparable hardness of the granules produced in the four Examples was determined by taking each of the products and placing 100 grams thereof on a No. 40 riddle on a standard testing machine. Each of the samples was subjected to oscillation and tapping action for four minutes. The weight percent of each sample remaining on the 40 mesh screen was then determined. The results are given in Table I below.

TABLE I

	Example Number			
	1	2	3	4
% sample remaining on the 40 mesh screen	96.6	96.1	97.2	97.7
% sample lost through the 40 mesh screen	3.4	3.9	2.8	2.3

The ability of the granules of each Example to quickly disintegrate when wet was measured. This was accomplished by spreading a 100 gram sample of each of the final products of the four Examples in a 12 inch diameter pan and covering the particles

with water to a depth of 1/2 inch. The particles began to crumble and "boil" apart due to the swelling or expanding action of the clay binder material.

When all visible action stopped, the water and product were gently introduced onto a 100 mesh screen and one quart of water was used to gently wash the remaining particles on the screen. The remaining particles were dried and weighed. In Table II below, the percentage of material remaining on the 100 mesh screen is compared to the amount of original mix from the pulverizer, prior to granulating, which would be retained on a 100 mesh screen.

TABLE II

	Example Number			
	1	2	3	4
% material retained on the 100 mesh screen:				
disintegrated granulated material	28.3	25.3	32.8	37.4
original pulverized mix	28.6	24.1	31.1	36.2
time in seconds required for granulated material to start disintegrating	20	28	42	45
time until visible disintegrating action stopped	6 min. 35 sec.	5 min. 45 sec.	8 min. 9 sec.	9 min. 15 sec.

None of the products of the four Examples above are hygroscopic and therefore are not materially affected by being exposed to the atmosphere.

As indicated above, the granules of the present invention have uses other than as a soil neutralizer. For example, they could be used as a fertilizer filler. It is common practice in fertilizer blending plants to mix a filler material such as crushed stone or sand with the other ingredients making up the complete fertilizer. When limestone is used as a filler, for example, it will generally be crushed to a size such that 100% will pass a 6 mesh screen and 100% will be retained on a 16 mesh screen. This particle size will correspond to the particle size of the fertilizer granules. To make such an accurately sized product is expensive and no real benefit is derived from the filler material.

Through the use of the granules of the present invention, a limestone pulverized to the extent that 70% will pass a 100 mesh screen, for example, may be formed into granules of appropriate size for a harmless filler material. In use, however, the granules will quickly dissolve, making the fine limestone rapidly available as a soil neutralizer so that the filler material will indeed be of some benefit.

Examples of the use of the granules of the present invention as a fertilizer filler may be given as follows:

EXAMPLE 5

Fertilizer Grade—15-15-15
456 pounds of Potash
652 pounds of Diammonium Phosphate
406 pounds of Urea
458 pounds of granules in the form of Pelletized Limestone

EXAMPLE 6

Fertilizer Grade—6-6-18
330 pounds of Ammonium Nitrate
260 pounds of Triple Super Phosphate
700 pounds of Potash
710 pounds of granules in the form of Pelletized Limestone

EXAMPLE 7

Fertilizer Grade—0-25-25
1060 pounds Triplesuperphosphate
810 pounds Nitrate of Potash
130 pounds of granules in the form of Pelletized Limestone

Fertilizers have what is known as a "potential acidity in terms of calcium carbonate equivalent" which is normally indicated on each bag of fertilizer. The granules of the present invention may be mixed in exactly the right proportion with any grade of fertilizer to completely neutralize the potential acidity thereof, allowing the fertilizer manufacturer of mixes to produce and sell a completely neutral fertilizer.

An example of granules of the present invention mixed in the right proportion with a fertilizer to completely neutralize the potential acidity thereof is given as follows:

EXAMPLE 8

The potential acidity of 10 pounds of 22-5-5 grade fertilizer, which requires 600 pounds of calcium carbonate per ton to neutralize the potential acidity thereof is neutralibed by mixing therewith 3.33 pounds of pelletized raw material, such as limestone.

The uses of the granules of the present invention are not necessarily restricted to those associated with the soil. It is common practice, for example, to use calcium carbon-

ate as a calcium source for livestock, poultry and other animals. The calcium carbonate is generally mixed with the feed. The size of the calcium carbonate particles is usually determined by the size of the other particles making up the feed. The particle size of all of the feed ingredients must be approximately the same to avoid segregation, but cannot be so fine as to be dusty. As a result of this, very little consideration can be given to the particle size of the calcium carbonate with respect to that which would be ideal for maximum availability of the calcium carbonate to be taken up by the animal's body in the stomach and intestinal tract. Generally, a particle size such that 100% is retained on an 80 mesh screen is used, which size is too large to obtain efficient results and a significant portion of the calcium carbonate fed to the animals passes through them and is wasted.

In accordance with the present invention finely ground calcium carbonate (70% passing a 100 mesh screen, for example) could be formed into granules of appropriate size (for example 100% passing an 8 mesh screen and 100% retained on a 20 mesh screen). The granules could be mixed with the feed, but will quickly dissolve in the animal's stomach and return the calcium carbonate to its powder form which is far more readily taken up by the animal's body. This would result in a reduction in the amount of calcium carbonate required to be fed to each animal with an attendant cost savings.

In coal mines it is a common practice to mix finely ground high calcium limestone (for example, that which will pass a 200 mesh screen) with water and spray it on the mine entry walls and flood to hold down coal dust and lighten the colour of the entry surfaces. When granules of the present invention are used for this purpose, they may be more conveniently handled in bag or bulk, thereby reducing the overall cost of the operation.

In a similar manner, the granules of the present invention may be used in water treatment facilities. Furthermore, the granules of the present invention may be used to soak up and neutralize water, manure, etc., on the floors of barns and stables and water, grease, etc., in workshops, factories and the like.

WHAT WE CLAIM IS:—

1. Granules consisting of from 90% to 98% by weight of a finely-divided calcium and/or magnesium-bearing raw material selected from the group consisting of limestone, dolomitic limestone, burned lime, marl, oyster shells, and slag, and 2% to 10% by weight of a binding agent selected from the group of high-expansion clays consisting of sodium bentonite, calcium bentonite and montmorillonite, the binding agent causing cohesion of the raw material into granules which disintegrate when in contact with water; the granules being of a size that they will pass a 4 mesh screen and be retained on a 60 mesh screen.

2. Granules according to claim 1, wherein the granules are of a size that they will pass a 4 mesh screen and be retained on a 20 mesh screen.

3. Granules according to claim 1, wherein the granules are of a size that they will pass a 20 mesh screen and be retained on a 60 mesh screen.

4. Granules according to claim 1, wherein said raw material comprises 97% to 97.9% by weight and the binding agent comprises 2.1% to 3% by weight.

5. Granules according to claim 1, wherein the raw material comprises limestone and the binding agent comprises sodium bentonite.

6. Granules according to claim 1, wherein the raw material comprises limestone and the binding agent comprises calcium bentonite.

7. Granules according to claim 1, wherein the raw material comprises dolomitic limestone and the binding agent comprises sodium bentonite.

8. Granules according to claim 1, wherein the raw material comprises dolomitic limestone and said binding agent comprises calcium bentonite.

9. A process of preparing granules which comprises the steps:

(A) mixing from 90% to 98% by weight of a dry, finely divided calcium and magnesium-bearing raw material selected from the group consisting of limestone, dolomitic limestone, burned lime, marl, oyster shells, and slag, with from 2% to 10% by weight of a binding agent selected from the group of high expansion clays consisting of sodium bentonite, calcium bentonite and montmorillonite;

(B) agitating the mixture and gradually adding from 6% to 15% by weight of water, based on the weight of the dry material, to the dry mixture to form granules, said water being sufficient in amount to activate the binding agent and less than an amount required to form a slurry;

(C) drying the granules at a temperature within the range from 200° to 600°F; and

(D) screening the dried granules to recover those granules having a particle size which will pass through a 4 mesh screen and be retained on a 60 mesh screen, said granules containing from 90% to 98% by weight of said raw material and from 2% to 10% by weight of said binding agent.

10. A process according to claim 9, wherein following said initial mixing a portion of the mix is continuously recycled for further

mixing to produce the needed percentage of fines for a more uniform final product.

11. A process according to claim 9, wherein 8% by weight of water, based on the weight of the dry material is gradually added to the dry mix during said agitating step.

12. A process according to claim 9, wherein the granules are dried at a temperature of about 350°F.

13. A process of preparing granules according to any one of claims 10 to 12, which includes grinding with the initial mixing of step (A), and wherein the grinding and mixing is accomplished in one step by use of a cage mill whereby the necessity for predrying the calcium and magnesium-bearing raw material prior to grinding is eliminated.

14. Granules according to claim 1, substantially as herein described.

15. Granules according to claim 1, when used as a fertilizer filler substantially as herein described with reference to any one of the foregoing Examples 5 to 8.

16. A process of preparing granules according to any one of claims 10 to 13, substantially as herein described with reference to the accompanying drawing.

17. A process of preparing granules substantially as herein described with reference to any one of the foregoing Examples 1 to 4.

18. Use of the granules of any one of claims 1—8, 14 or 15 as a soil neutralizer and conditioner.

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1 465073 COMPLETE SPECIFICATION

1 SHEET

This drawing is a reproduction of the Original on a reduced scale.